EVALUATION OF A VEGETABLE PREPARATION TRAINING PROGRAM PART II: ASSESSED BY PLATE WASTE OBSERVATION, STUDENT AND SENSORY PANEL RATINGS

by

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INTRODUCTION

In 1946, the United States Congress passed the National School Lunch Act to ". . . safeguard the health and well being of the nation's children and to encourage the domestic consumption of nutritious agricultural commodities" (1). The school lunch program has expanded since 1946. However, increasing meal costs and plate waste and declining participation in recent years has proved to be costly in dollars and cents as well as in loss of nutrients (2).

Studies by Martin (3), Doucette (4), and Walling (5) indicated plate waste was higher in elementary schools than in the secondary schools and that vegetables were consumed at a substantially lower level than other menu items. Jansen et al. (6) reported that food served at the proper temperature with good color, texture, and flavor was consumed better by students, had a higher nutritional quality, and was safer from a microbiologic standpoint, than that served at lower temperatures.

Several studies (2,7,8) to determine children's food preferences have found that less than half of the children studied liked vegetables, whereas over two thirds liked fruits. The fact that vegetables are generally unpopular may reflect the many and possibly unsatisfactory ways in which they are prepared (9).

In 1977, the Government Accounting Office (GAO) recommended that the United States Department of Agriculture (USDA) expand the National School Lunch Program and instruct foodservice personnel in an effort to reduce plate waste by improving food appearance and quality (10). The need for vegetable preparation training of school foodservice employees has been reported in studies by Gutsch (8), Johnson (11) and Rieley et al. (12).

Based on recommendations by Rieley et al. (12), a study in two concurrent parts was devised to evaluate the effectiveness of an employee training program as a means of improving quality of cooked vegetables in school foodservice. Objectives of part one of the concurrent study by Rufael (13) are:

- to assess temperatures and holding times of cooked vegetables in current practice at five elementary schools,
- to conduct an on-site training program on batch cooking of vegetables, and
- to assess the effectiveness of training by recording temperatures and holding time of cooked vegetables.

Specific objectives of this study are:

- to assess the influence of vegetable preparation training on the amount of vegetable plate waste,
- to compare student ratings of cooked vegetables before cooks' training to ratings after training, and
- to determine if quality characteristics, as measured by a professional sensory panel, are affected by proper training in vegetable preparation techniques.

Definition of Terms

Sensory Evaluation--a scientific study to measure, analyze, and interpret reactions to those characteristics of goods and materials as they are perceived by the senses of sight, smell, taste, touch, and hearing.

Hedonic Scale--a scale used to measure the amount of like or dislike for a food or object, expressed in numerical values.

Acceptability--expressed degree of like or dislike for a food item.

Plate waste--the amount of food that remains on a plate after a person has finished the meal.

REVIEW OF LITERATURE

Literature reviewed in part one of the total study consisted of only those references pertinent to time and temperature effects on food quality and employee training (13). The National School Lunch Program, acceptability ratings for school lunch, and sensory evaluation are reviewed in part two of the study and appear in the following review of literature.

Historical Background of National School Lunch

The concept of the modern school nutrition program grew out of the discovery during World War I, that many young men were not fit for military service because of physical deficiencies due to malnutrition. Again in the early forties, thousands of young men were rejected during World War II for physical deficiencies related to malnutrition. While the youth of the nation faced malnutrition, vast quantities of surplus foods were on hand because American people did not have enough money to buy them. Therefore in 1946, Congress enacted the National School Lunch Act (1) as a measure to safeguard the health and well-being of the nation's children and to increase the market for agricultural commodities. Policies developed for implementation of the National School Lunch Act were:

- programs would be operated on a non-profit basis;
- meals must meet the standards set forth by the United States Department of Agriculture (USDA) to qualify for reimbursement;
- free and reduced price lunches must be offered to those unable to pay the full price, in order to qualify for federal cash and/or commodity assistance.

Funds were appropriated to states on a matching basis, according to need and predicated on the number of school children and per capita income. In addition, funds for non-profit assistance and purchase of agricultural commodities were provided.

Martin (3) stated that nutritional research was to be the foundation of the school lunch program. Nutritional requirements for lunches served in the National School Lunch Program (NSLP) were expressed as the Type A pattern which was to provide approximately one-third of the child's Recommended Dietary Allowances (RDAs) as defined by the National Research Council. The Type A pattern must consist of:

1 serving of meat or meat alternative
2 servings of fruits or vegetables
1 serving of bread
½ pint of milk

Nutritive standards, set by the National Research Council (NRC), are recommendations for average daily amounts of nutrients that population groups should consume over a period of time. The NRC stated several considerations are necessary when the RDAs are used as a basis for estimating food requirements and meal patterns for school lunch programs, special food services, and various child feeding programs. First, the RDAs should be met with a wide variety of foods. Second, foods must be palatable and acceptable so they will be consumed over a long period of time in required quantities. Finally, to meet the RDAs adequately, a supply of food for one week should include all nutrients at allowance levels in proportion to energy (14).

Child Nutrition Legislation: 1954-1985

The Special Milk Program was established in 1954 to promote increased milk consumption by children in non-profit schools. Milk purchased by students was subsidized in excess of the number of pints served as a part of the school lunch (15).

In 1962, PL 87-823 (16) amended the National School Lunch Act to correct funding inequities by basing apportionments on the participation and assistance need rates of each state. In addition, special assistance was authorized via cash reimbursements for free or reduced price meals. National School Lunch Week was established by a Joint Congressional resolution and by Presidential proclamation to be observed annually each October. Title I of the elementary and Secondary Education Act (ESEA) of PL 89-10 (17) was passed by Congress in 1965, and provided funds to establish school lunchrooms where none existed.

The Child Nutrition Act of 1966 (18) established funding for pilot breakfast programs to schools drawing attendance from areas of economic need, authorized grants-in-aid for foodservice equipment in economically depressed areas, and provided funds for defraying administrative costs. In 1968, Congress enacted PL 90-302 (19) which amended the National School Lunch Act to continue the School Breakfast Program through Fiscal Year 1971. In 1969, under a Presidential directive, the Food and Nutrition Service was created as an agency in the USDA to administer federal food programs (20).

With enactment of PL 94-105 (21) in 1975, the offering of reduced priced lunches was no longer optional. The definition of school was broadened to encompass licensed public or non-profit private or public residential child care institutions such as orphanages and homes for the mentally retarded to participate. As part of an effort to reduce plate waste, Congress mandated the offer versus serve provision in the school lunch program under which students were required to select only three of the five components of the Type A lunch.

In 1977, PL-95-166 (10), National School Lunch and Child Nutrition Amendment, extended the offer versus serve option to include junior high and middle school students when approved by the local school authority. Funds for nutrition information and education programs were added to the services of children. Included in this legislation, the Secretary of Agriculture was given authority to regulate the sale of competitive foods which are defined as those of minimal nutritional value. These contain less than 5 percent of the RDAs for protein, Vitamin A, ascorbic acid, niacin, riboflavin, thiamin, calcium, and iron per 100 calories per serving. The USDA prohibited sale of carbonated beverages, water ices not made with fruit or fruit juices, chewing gum, and candy during the lunch period.

The term Type A was eliminated in 1979 and meal requirements were retitled School Lunch Meal Pattern. School foodservices were encouraged to offer portion sizes tailored to meet the nutritional needs of five age groups, and guidelines for minimum quantities for each group were provided (22). Federal reimbursement required provision of four components in the school lunch: meat or meat alternative, fruit and/or vegetable, bread or bread alternative, and milk.

Reduced federal support and increasing emphasis on transferring federal responsibility to the states in the early 1980's prompted enactment of the Omnibus Reconciliation legislation (23), which included cutbacks in child nutrition programs. Included in this legislation, the offer vs. serve option was authorized for elementary schools to reduce plate waste costs. The Comptroller General reported to the United States Congress in 1981 that many school foodservice programs are faced with increasing meal costs and plate waste and declining student participation (24).

The Gramm-Rudman balanced budget amendment (25), passed by the Senate on October 10, 1985, is essentially a five-year plan to balance the federal budget, establishing specific targets for the years 1986 through 1991. Programs administrated by USDA's Food and Nutrition Service are slated for a host of budget reductions under the Gramm-Rudman amendment.

Sensory Quality

Blaker et al. (26) stated that of all the possible stresses on sensory quality during meal distribution, hot holding has caused greatest concern. Hot holding or warm holding of food is accomplished through the use of a stationary steam table or movable cart (27). Dahl (28) contended that sensory quality losses through hot holding can be reduced, however, by proper control of the environment and temperature.

Time-Temperature Studies

A study by Blaker et al. (26) was undertaken to ascertain temperatures at which individuals prefer to eat foods. Four classes of foods were studied: soups, vegetables, entrees, and beverages. Results indicated that customers preferred foods at the following temperatures: soups 145-150°F, entrees 140-145°F, and hot beverages 145-150°F.

Blaker and Ramsey (29) found that visible changes in quality occurred during holding time in steam tables. Factors necessary to produce top quality food at temperatures most acceptable are the same needed to produce safe food. Foodservice operators who adhere to recommended preparation procedures, temperatures, and holding times should be able to meet both the standards of quality and wholesomeness. Results indicated that a combination of time and temperature had a greater effect on the appearance and palatability of green vegetables than either time or temperature alone. They concluded that long holding periods will result in mushy discolored products and loss of nutrients.

Jansen and Harper (30) conducted research in fifty-eight schools selected by the Food and Nutrition Service of the U.S. Department of Agriculture to compare the Type A lunch with those planned to meet a predetermined nutritional standard. Results indicated food served at the proper temperature and with good color, texture, and flavor would not only be consumed better, but would also be of higher nutritional quality and safer from the microbiological standpoint. The authors stated that greater attention to factors in training programs could help reduce plate waste in schools where waste is currently above acceptable levels.

Brown et al. (31) reported in a 1982 study that proper use of equipment suited to food production can contribute to reduced preparation and holding times and assist in maintaining quality of the finished product. The researchers recommended that continuous training of foodservice employees is needed to improve food preparation, transportation, and service in school foodservice systems.

Foodservice System Studies

Harper et al. (32) reported on menu item acceptability in four types of delivery systems. Data indicated that on-site preparation and service resulted in significantly less plate waste than did chilled or frozen preportioned in a satellite kitchen. The researchers stated if school lunch programs do not deliver acceptable food the nutritional benefits will not be received by the students, emphasizing the need to study acceptability as affected by delivery systems.

Johnson (11) studied the acceptability of entrees and vegetables in on-site and satellite school foodservice systems. Students in the fourth and fifth grades from eight elementary schools participated in the study. Plate waste tended to be higher in satellite schools compared to those with on premise production of food. For all vegetables studied, plate waste decreased as acceptability ratings for flavor and appearance increased.

Rieley et al. (12) evaluated the effect of type of school foodservice system on quality and acceptability of broccoli, chicken nuggets, and potato products. The three systems evaluated were conventional, satellite, and satellite with finishing kitchen. Data indicated temperatures were highest for the conventional system for all food items; whereas, the satellite system had the longest holding times. Plate waste was significantly lower in the conventional system than in the satellite for chicken nuggets and potato products. Broccoli waste in the conventional system was significantly lower than waste in the satellite or satellite with finishing kitchen. The conventional system tended to receive the highest student acceptability ratings for flavor, appearance, and temperature, whereas, satellite with finishing kitchen received the lowest ratings. The researcher concluded that training employees in preparation techniques may be indicated and stated that additional research was needed to assess if proper preparation techniques would improve the quality of food served in the three types of foodservice systems.

Sensory Evaluation

Laramound (33) stated that sensory evaluation is made by the senses of taste, smell, and touch when food is eaten. The complex sensation from the interaction of our senses may be used to measure food quality. He contended two types of tests are used in sensory evaluation, affective and analytical. Affective tests are used when information regarding preference and acceptability are desired. Analytical tests are used with trained panelists, who evaluate products for differences or similarities and for sensory characteristics.

According to Skelton (34), a trained sensory panel is relatively small, ranging from six to 12 persons who must be available and willing to participate repeatedly. The distinctive purpose of the trained panel is judging quality characteristics and differences among food items, rather than considering acceptance or preference. To facilitate the testing, panel members should be well trained in the use of a scorecard and in the vocabulary of food description.

Rieley et al. (12) stated that sensory evaluation by an expert panel is an objective means of measuring the quality of food items served in school foodservice. In this study, data indicated a low correlation between student acceptability ratings of flavor and appearance and some of the sensory ratings, suggesting a limited relationship between sensory quality and student acceptability.

Measures of Acceptability

Hedonic Scales

The Food Action Rating Scale (FACT) a nine point scale developed by Schutz (35) was constructed by psychological scaling techniques. It requires the individual to be very specific about what actions he would take in terms of the number of times he would be interested in eating a food product in a given period. Data indicated that the hedonic scale and the FACT method correlate well with each other showing strengths in different areas (35). The FACT scale shows more sensitivity at the "like extremely" end of the scale since it asks the respondent to indicate the number of times he or she would like to eat the food (i.e., twice a week, once a day, twice a day and so on).

The purpose of acceptance testing is to determine the overall degree of like or dislike for a food, and how much this preference varies. For example, food may have a good average rating because almost everyone likes it to a fair degree; or it may have a good average rating because a large number of respondents like the food very much and another large number dislikes it very much. The hedonic scale is used to measure the level of liking for food products by a group of people and it may be applied in testing for preference or acceptance. The traditional hedonic scale consists of nine categories with a continuum from "like extremely" through "dislike extremely." Two variations of this scale are a seven and a five point scale (36).

Head et al. (7) stated that methods for measuring food acceptability can be divided into two main categories: qualifying plate waste to measure behavioral responses, and rating items on a hedonic scale to measure affective responses. The researchers compared three types of information for assessing student acceptability of school served food items: a hedonic rating, self reported consumption, and plate waste. Results indicated acceptability ratings are very good indicators of consumption.

Plate Waste

LaChance (37) stated that plate waste can be used to measure preference, monotony, adequacy of serving size, and nutrient intake. He presented a simple procedure to estimate plate waste for school foodservice workers. He reported the visual method can provide reliable data if performed in a systematic manner.

According to LaChance (37), the visual method of measuring plate waste requires observers, trained to recognize average serving sizes of each food item, to use a scale to rate each food item on the tray returned at the end of a meal. The observer records their judgments regarding the proportion remaining on the tray. Comstock et al. (38) validated the LaChance method of measuring plate waste and found trained data collectors can make visual estimations of plate waste that correlate highly with actual percent waste.

Stalling and McKibben (39) also validated the LaChance procedure of visual assessment of plate waste by using observers with little prior experience estimating portion size. Fourth and fifth grade students in selected elementary schools were used as test subjects. During each visual assessment, tags were placed on the first 50 plates returned following lunch. After tagging the plates, a single observer assessed the food waste on each plate using a five point scale. Following visual assessment, individual food item waste from each plate was placed into a separate container and weighed on a dietetic scale. Actual weights were compared with assessed percentages to establish validity. Data indicated that visual assessment seems a reliable and simple method for plate waste assessment.

Graves and Shannon (40) examined plate waste with the use of two techniques of data collection: physical weighing and visual assessment. Data reported focused on comparison of results obtained from the two measures of plate waste, comparison of plate waste between boys and girls, and influence of grade level on plate waste. Data reflecting consumption of foods offered in an elementary school cafeteria were collected over a four-day period prior to and after implementation of a nutrition education program. The researchers concluded that the two measurement techniques provided similar data on all food items except stewed tomatoes, in which the visual method consistently exhibited a higher percent plate waste. Sex of the child appeared to influence the amount of the food wasted, with the plate waste of 18 food items being higher for girls than for boys. Plate waste of six food items were influenced by grade level; however, no consistent trend from lower to higher was observed.

Johnson (11) compared weighed plate waste measurements to that of visual observation and self-reported consumption. She found that visual and self-reported methods of estimating plate waste may be as accurate as weighed plate waste data because of the variability of serving size. The correlation coefficients between weighed and self-reported measurements were .76 and .77. The correlation between observed and self-reported plate waste also indicated close agreement.

Factors Affecting School Lunch Participation

Doucette (4) used a questionnaire to investigate attitudes of Hawaiian high school students toward school lunch. Results showed that schools with new, attractive lunchrooms received above average ratings for their lunches, and staff members in those schools were considered more pleasant. A school with an overcrowded, unattractive lunchroom received a lower than average lunch rating.

Gutch (8) studied the influence of offering choices in vegetable menu items of food acceptability in the school foodservice program. During the control period regularly planned menus, which did not include choices in vegetable menu items, were served at the junior high school. During the experimental period, the regularly planned menus were served with the addition of another vegetable menu item, allowing the students to have a choice each day. A student foodservice attitude study, also administered as part of the study, consisted of a pre-test and a post test. Twenty-four vegetables were used to study preferences of students at home and at school. Several college students were employed to assist with the collection of the vegetable plate waste. When the students and the faculty brought their trays to the dishroom window, college student assistants scraped the uneaten vegetables into pans, which were weighed after each of the five lunch periods.

Results indicated that total ounces of vegetables left uneaten decreased during the experimental period. The vegetable preference questions of the attitude survey revealed potato products and corn were the favorite vegetables of junior high school students. Evidently, vegetables are not a popular item. Gutch concluded from her study that methods of vegetable preparation should be given particular attention in the school foodservice operation.

Garret and Vaden (9) studied the influence of student-selected menus on participation, plate waste, and attitudes toward school foodservice of sixth grade students in three elementary schools. Participation, plate waste, and student attitudes were measured during a period of manager planned menus. Following this period, sixth grade students were asked to rate the school lunch program and to complete a food preference instrument consisting of a list of 161 items regularly offered on the district's school lunch menus. Students were asked to rate each food using the scale: (a) like a lot, (b) like, (c) dislike and (d) do not know.

Results of the food preference survey were then used to assemble 72 menus utilizing preferred foods. A 16 day cycle menu was devised and then used. Plate waste and participation were measured again during this experimental period when student planned menus were served. Results indicated that the average percent participation in the school lunch program increased significantly and per student ounces of plate waste decreased.

Jansen and Harper (30) reported that reducing plate waste depends on many factors and will require action. Possible causes of plate waste beyond non-acceptability of food items and the menu include time available for lunch, lighting and general atmosphere of the lunch room, noise level of the lunch room and the presence and/or absence of choice.

Davidson (41) found many factors affect school lunch participation, plate waste, and student's attitudes. The researcher studied factors affecting school lunch acceptance in 23 elementary schools which served preplated lunches but differed in environmental organization. Non-food factors, such as adult supervision, were found to be related to the success of the school lunch program. She concluded that the surroundings perceived as unpleasant by students could ruin a program with excellent food quality.

Lilly et al. (2) stated that a basic objective of the National School Lunch Program has been to aid in the formation of good eating habits in the lunchroom. Some food waste, however, is inevitable since children are served nutritious foods that may differ from foods served at home. According to Lilly et al. (2), the USDA has initiated or implemented many activities in an attempt to improve food consumption. These activities include proposing revisions in meal requirements, implementing offer vs serve provisions, proposing regulations concerning sale of foods in competition with school lunch, encouraging on-site food preparation, implementing training programs for personnel, and implementing nutrition education programs.

METHODOLOGY

Recommendations of Rieley et al. (12) for further research to determine the effectiveness of training employees on proper preparation techniques as a means of improving quality of cooked vegetables consitituted the basis for this two part project. Part 1 by Rufael (13) consisted of development, implementation, and partial assessment of a cook's training program consisting of group and on-site sessions. In part 2, further effectiveness of the program was assessed using student ratings, plate waste measurements, and sensory evaluation.

Research Site

The study was conducted in five elementary school foodservices in a medium sized midwestern city in which steamers were used to cook frozen vegetables. Currently, the district utilizes three types of foodservice delivery systems: conventional, satellite, and satellite with finishing kitchen. Only the conventional and satellite with finishing kitchen were selected for this two part study. Schools A and D have conventional food delivery systems and B, C, and E are satellites with finishing kitchens. Coordination with the school Foodservice Director, who was responsible for menu writing, assured that chopped broccoli, the vegetable selected for this part of the study, was served on the days scheduled for the research.

Student Sample

Fifth and sixth grade students, who received school lunch the days of data collection, were used in the study. Students were asked to evaluate their broccoli, and observation of broccoli waste was made when students returned their trays.

Seating arrangements in the lunch room varied among the schools in the study; in some schools fifth and sixth grade students ate separately, in others they ate with other grades. Students who brought their lunch from home and students not present at school on data collection days may have contributed to differences between the number of student forms and plate waste observations within a given school on different dates. Since students had the option of not completing the evaluation forms, yet all had their plate waste assessed, observations were often greater than the number of evaluation forms.

Research Design

Several frozen vegetables were used in part 1 of the study for observations on temperature and holding time, but only frozen chopped broccoli was used in part 2 for assessment of quality. Broccoli was chosen because of the readily observable effects of preparation techniques on color, texture, and acceptability. Observation of preparation techniques indicated the desirability of the training program for cooks as a corrective measure. The training program developed by the researchers and participated in by both is described by Rufael et al. (13) in part 1 of this study.

Student evaluations of the quality of the broccoli, plate waste data, and sensory quality ratings were collected on two non-consecutive days both prior to and after the vegetable preparation training. Fixth and sixth grade students were chosen to complete student evaluations because of their ability to read and use forms without assistance.

Plate waste was assessed by members of the Research Support Group, consisting of graduate students, trained in using the visual method of assessing plate waste. An experienced professional panel was employed to provide sensory characteristic data.

Project Approval

Prior to data collection, the project was reviewed by the College of Human Ecology's subcommittee on research involving human subjects. The study was exempted from human subject review as stated in Federal regulation 45 CFR 46 since students receiving vegetables would do so regardless of data collection. Approval was then sought from the Dean of the College of Education in accordance with an agreement between the school board and the college. Correspondence with the Dean related to this request and its approval is included in Appendix A, as is the cover letter for the copy sent to the District Superintendent of Schools. The Dean, in a letter to the Superintendent, recommended favorable consideration of the project, and approval was granted. Following approval, the Superintendent of Schools explained the study to the school principals at a scheduled meeting.

Data Collection Forms

Information for the research included student acceptability ratings of broccoli, records of plate waste for cooked frozen broccoli and analytical sensory ratings. Forms, in single sheet format, were either adapted from previous research or specially developed for collecting information for this study.

Student Evaluation Card

The student evaluation card (Appendix B) was adapted from one developed for the Rieley study (42). The heading of the card included name of the school and date. Fifth and sixth grade students were asked to evaluate taste and looks of broccoli using a five point hedonic scale: great, good, so-so, bad, and awful. A three point hedonic scale was used to evaluate temperature and amount served. Temperature alternatives were too hot, just right, and too cool; amount served was rated by too much, right amount, and too little. Data from the student evaluation cards were not linked to individual students.

Plate Waste Form

The observational plate waste form (Appendix B) was adapted from the Johnson study (11). The principal change in adapting the Johnson observational plate waste form was restructuring the rating scale from five points to four. This change had been recommended by

Johnson. The heading of the form included name of school, date, and rating scale. The number of trays observed was indicated in a numbered column with each number showing the rating scale from 4 to 0. Data collectors visually estimated plate waste for each tray and circled the number corresponding with the portion of broccoli remaining on a student's tray. Trained observers estimated plate waste on each tray assigning one of the following categories to each food item. The following scale was used for the amount of vegetable remaining on the tray:

4--if a full portion remained
3--if three-quarters of a portion remained
2--if one-half of a portion remained
1--if one-quarter portion remained
0--if none remained
(-)--if there was no evidence that the food item was served

Sensory Evaluation Score Card

The sensory evaluation score card (Appendix B) was adapted from the one used in the Rieley (42) study. The heading of the card indicated name of the observer, date, and name of school. The recording space included instructions for use of the form. Space was provided for recording the temperature of the broccoli. Purity of green was indicated by a vertical mark on a 15 centimeter line with end points of extremely dull to extremely bright. Firmness was evaluated by a vertical mark between the end points of very mushy and very firm. Space also was provided for the observer's comments.

Preparation of Observers

Research Support Group

The Research Support Group consisted of a team of eleven graduate students in Institution Management; one was added to provide a back up for the ten required. Members of this group were asked to participate in training in plate waste observation. Following training, members were divided into two groups; one group distributed and collected student evaluation forms and the other observed and recorded the plate waste.

Plate Waste Observers

Plate waste observers were trained to judge the portion size of broccoli remaining on the school lunch trays using the method described by LaChance (37). Broccoli was cooked in a steamer and weighed on a digital scale in the following four portion sizes: full serving (.086 lb.), three-fourth serving (.065 lb.); one-half serving (.043 lb.), and one-fourth serving (.022 lb.). As an example, each of these portions was placed on an individual school lunch tray.

Trays were displayed for observation by the group responsible for checking plate waste. Observers were shown the form for recording plate waste (Appendix B). Ten new trays were assembled with varying amounts of broccoli simulating plate waste; weight of the broccoli was marked on the underside of each tray.

Observers were than asked to circle on the observation form their estimate of the portion size on the tray. This procedure was repeated until observers were completely familiar with both the form and observation technique. The five observers with the most accurate estimates were selected to observe plate waste; the remaining five were assigned to distribute and collect student evaluation forms. A review session was scheduled for plate waste observers prior to data collection before and after the vegetable preparation training.

Sensory Panel

The sensory panel was well trained and only familiarization with the project was necessary. To demonstrate the end points of the observation scales, broccoli was prepared exemplifying the highest and the lowest qualities as well as several points in between. An alternate panel member was also trained. Characteristics of purity of green and firmness were discussed by panel members under the direction of the panel director. The broccoli was delivered to the sensory research laboratory, where the panel director explained the form that would be used and the details of the study.

Data Collection

Student Evaluation

Fifth and sixth grade students from each of the five elementary schools were asked to evaluate the broccoli, using the student evaluation form described earlier (Appendix B). The evaluation form was distributed and collected by a member of the Research Support Group on two non-consecutive days prior to the cook's vegetable preparation training and on two non-consecutive days following the training. Students marked the card, according to instructions with a pencil which was provided. Blue cards were used before the cook's special training and green afterward.

Plate Waste Observation

Plate waste was assessed by members of the Research Support Group using the accepted visual observation technique. Fifth and sixth grade student trays were observed upon return to the dishroom. Plate waste observers were randomly assigned to each of the five schools on two non-consecutive days, prior to and following the cook's vegetable preparation training sessions. Schedules of school assignments are in Appendix C.

Sensory Evaluation

A six member professional panel from Kansas State University was employed to evaluate the broccoli for sensory characteristics. The panel was divided into three groups, each consisting of two panelists. Two groups were assigned to collect data from two of the five schools and one group to one school (Appendix C). Specific assignments were in accordance with serving time schedules. Forms (Appendix B), thermometers, and schedules were given to panel members each morning of data collection.

To avoid possible bias, each panelist was randomly assigned to a school for each day of data collection. On two non-consecutive days prior to vegetable preparation training of cooks, panel members reported to the assigned schools during the lunch period. Each was given a tray with a serving of broccoli from the steam table.

Panelists recorded the temperature of the broccoli using a pocket thermometer having a range of 20 to 105°C and then evaluated the broccoli for sensory characteristics. The identical procedure was followed on two occasions after the vegetable preparation training of the cooks (Appendix D).

Data Analysis

Programs and routines in the Statistical Analysis System (SAS) were used for all data analysis (43). The initial analysis included compilation of frequencies by date and school for all student, plate waste data, sensory.

Means were computed by date and school for student and sensory ratings. Before computing means for plate waste observations, the response "no evidence the food was served" was deleted.

A general linear model analysis was used to compare pre and post training student, plate waste data, sensory. Since data were unbalanced, techniques described by Milliken and Johnson (44) for analysis of split-plot experiments with unbalanced data were used.

Pearson Correlation Coefficients were used to examine relationships among the student, plate waste, sensory ratings. Correlations were examined both across all schools and within each school.

RESULTS AND DISCUSSION

Student evaluations, plate waste observations, and sensory ratings of chopped frozen broccoli were collected in five elementary schools on two non-consecutive days both prior to and after cooks received training on vegetable preparation. Data collected prior to training are identified as pre-training and data collected afterward as post training.

Student Evaluations

Comparison of student ratings of flavor, appearance, temperature, and serving size for broccoli pre- and post training are given in Table 1. No consistent pattern was found among schools when comparing pre- and post training ratings. Student ratings for flavor and appearance were "bad" to "so-so" for all schools. Three of the five schools (A, B and D) showed improved ratings for flavor and two schools (B and D) for appearance following the cooks vegetable preparation training, although none of the improvements were significant. Students from school E rated flavor significantly lower following training compared to ratings before training. School C ratings for appearance also were significantly lower following training.

Students rated broccoli temperature "too cool" for all schools. However, temperature ratings were significantly higher in school A following training. This confirms findings by Rufael (13), in part 1 of the study, which showed a significant increase in serving

Table 1. Student ratings of flavor, appearance, temperature, and serving size of broccoli pre- and post training

school	student ratings[1]			
	flavor[2]	appearance[3]	temp[4]	serving size[5]
	← mean →			
school A				
pre-training	2.09	2.14	1.49	2.42
post training	2.19	1.95	1.82*	2.43
school B				
pre-training	2.43	2.26	1.57	2.48
post training	2.72	2.37	1.93	2.30
school C				
pre-training	2.57	2.29	1.57	2.22
post training	2.18	1.78*	1.36	2.28
school D				
pre-training	2.89	2.40	1.68	2.05
post training	2.97	2.46	1.63	1.94
school E				
pre-training	2.84	2.51	1.83	2.24
post training	2.32*	2.12	1.69	2.39

[1] N varies 37-147.

[2] Scale = 1, awful to 5, great.

[3] Scale = 1, awful to 5, great.

[4] Scale = 1, too cool to 3, too hot.

[5] Scale = 1, too little to 3, too much.

*$p \leq .05$.

temperature of broccoli at school A following training. Student ratings for serving size (Table 1) were "right amount" for all schools both pre- and post training.

Three of the five schools in this study and the student rating form were used first in the Rieley (42) study. Data from this study indicate a slight improvement in student ratings for broccoli flavor and appearance since Rieley's study. Rieley et al. (12) found that student ratings for broccoli flavor were "bad" for the conventional and satellite systems and "awful" in the satellite with finishing kitchen system. In her study, all schools received a mean rating of "awful" for appearance, "too cool" for temperature, and "just right" for serving size.

Plate Waste

Mean ratings of observed broccoli plate waste pre- and post training are shown in Table 2. A comparison of pre- and post data indicated a reduction in plate waste in three of the five schools following vegetable preparation training. A significant reduction in plate waste was evident in school D, and schools A and B showed improvement in plate waste although not significant. School D also had improved student ratings for flavor, appearance and serving size (Table 1) and improved sensory ratings for purity of green and firmness (Table 2).

Broccoli plate waste increased at school C following the vegetable preparation training, which may be related to the corresponding decrease in student ratings (Table 1). Student ratings for

Table 2. Mean ratings of observed plate waste of broccoli pre- and post training

school	N	mean[1]
school A		
pre-training	154	2.55
post training	153	2.48
school B		
pre-training	44	2.39
post training	60	1.95
school C		
pre-training	38	1.68
post training	130	2.31
school D		
pre-training	152	2.16
post training	161	1.04*
school E		
pre-training	74	1.90
post training	102	2.07

[1] Scale: 4, a full portion remains to 0, none remains, but you can tell if it has been served.

*$p \leq .05$.

flavor and temperature were somewhat lower and appearance ratings were significantly lower after training. Data from school C may also have been affected by the change in serving policy, which occurred during the research project. Prior to pre-training data collection, school C served the hot vegetable on a salad bar where students served the vegetable on their trays. Cooks were asked to serve hot vegetables from the steam table for the purpose of data collection. On two non-consecutive days before the cooks' training, students were served broccoli only if requested. On the first day, 70 students and on the second day 40 students were not served broccoli. At school C on two non-consecutive days after training, all students were served broccoli unless specifically refused, which resulted in double the number of student evaluations and plate waste observation.

These results tend to confirm those by Jansen and Harper (30) who reported that food served at proper temperatures and with good color, texture and flavor would be consumed better. Head et al. (7) and Johnson (11) also found that acceptability ratings were very good indicators of consumption.

Sensory Evaluation

Sensory evaluation scores for broccoli pre- and post training are shown in Table 3. Temperature of the broccoli was taken by members of the sensory panel at the time of evaluation. Separate unstructured 15 centimeter line scales were used for rating purity of green and firmness.

Comparison of pre- and post training ratings indicated purity of green was improved, although not significantly, in three schools (B, C and D) and firmness improved in all but school A following training. Rufael (13), in part 1 of this study, found a significant reduction in holding time post training for all schools which may have contributed to improvement in broccoli quality.

School A showed a significant ($p \leq .01$) improvement in temperature, recorded by the sensory panel, post training. This

Table 3. Mean temperature and sensory ratings of broccoli pre- and post training

school	sensory ratings		
	temp[1] °C	purity[2] of green	firmness[2]
	← mean →		
school A			
pre-training	52.40	7.20	8.04
post training	68.00**	4.85	6.32
school B			
pre-training	61.50	7.05	6.47
post training	59.75	7.72	8.22
school C			
pre-training	60.80	7.28	6.80
post training	44.66**	8.15	8.65
school D			
pre-training	58.50	7.25	7.82
post training	53.50	9.30	8.65
school E			
pre-training	59.50	9.05	8.97
post training	57.50	7.92	9.35

[1] Temperature taken at time of sensory evaluation.

[2] Scale: 0, lowest to 15, highest intensity.

**$p \leq .01$.

agrees with results of the Rufael (13) study which found improvement in serving temperature of vegetables in school A. In this study, ratings on purity of green and firmness decreased in school A following training. One possible explanation may be that during post training data collection, the vegetable cook covered the pans of cooked broccoli with plastic wrap and foil to maintain temperature, resulting in a product that received lower quality ratings from the sensory panel. Conversely, school C showed a significant ($p \leq .01$) decrease in temperature at the time of sensory evaluation, and an increase in ratings of purity of green and firmness.

These findings confirm work by Klein et al. (45) who stated that prolonged holding times and accompanying fluctuations in temperatures reduce sensory and nutritional quality. Bobeng and David (27) stressed that quality of food is related to consumer acceptability which is often based on sensory attributes such as temperature, flavor, and appearance. Hill et al. (46) reported holding time is destructive to vegetable quality and recommended vegetables be consumed directly following cooking and not be subject to more than 30 minutes of hot holding.

Correlations of Post Training Data

Correlation coefficients for student ratings, plate waste data, and sensory ratings are shown in Table 4, and Tables 5 to 9 in Appendix D. According to Falkner (47), correlation coefficients of 0.00 to 0.39 are classified as low, 0.40 to 0.79 as moderate, and 0.80 and above as high.

Table 4. Correlations of student ratings, plate waste, and sensory ratings for broccoli post training[1]

	student ratings				plate waste	sensory ratings		
	flavor	appearance	temperature	amount		temp	purity	firmness
flavor								
appearance	.75**							
temperature	.53**	.45*						
amount	-.76**	-.44*	-.12					
plate waste	-.71**	-.48*	-.26	.70**				
temp	.10	.26	.45*	.25	.18			
purity	.19	.34	-.18	-.16	-.10	-.22		
firmness	-.09	.11	-.26	-.04	-.12	-.22	.80**	

[1] Data from all schools combined.

*Correlation significant at $p \leq .05$.

**Correlation significant at $p \leq .01$.

A moderate positive correlation (r = .75) was found between student ratings for flavor and appearance. A moderate negative correlation also was indicated between plate waste and student ratings for flavor (r = -.71) and appearance (r = -.48), indicating as ratings for flavor and appearance increased, plate waste decreased. Results from studies by Jansen and Harper (30), and Head et al. (7) indicated a relationship between consumption and acceptability ratings. Johnson (11) reported that vegetable plate waste decreased as acceptability ratings for flavor and appearance increased.

A moderate correlation (r = .70) was found between student ratings for amount served and plate waste; plate waste increased if students were served "too much." Such findings confirm Johnson (11) who reported that high plate waste was associated with student's perceptions of too cool temperatures of hot foods and too large portion sizes.

A high correlation (r = .80) existed between sensory panel ratings for firmness and purity of green. This is similar to findings of Rieley et al. (12) who stated such a result is not surprising, since loss of color and softening of texture occurs in broccoli cooked too long.

Low correlations were evident between student acceptability ratings and sensory quality ratings, although student ratings for temperature correlated moderately (r = .45) with temperatures recorded by the sensory panel. Rieley et al. (12) also found a low correlation between student acceptability ratings for flavor and appearance and some sensory ratings, suggesting a limited relationship between sensory quality characteristics and student acceptability.

Correlations for each school in the study are shown in Appendix D. Differences in correlations were found when data were reviewed by school. Results from school A (Table 5) showed a high negative correlation (r = -.94) between firmness of broccoli and amount served; fewer students responded they were served "too much" as firmness increased. A high negative correlation (r = -.99) for flavor and amount served was shown in student ratings at school B (Table 6) indicating that as perceptions of flavor improved, more students reponded they were served the "right amount" or "too little." A high correlation (r = .99) was found in school C (Table 7) between temperature and flavor. School D (Table 8) correlations show a significant (r = .95) relationship between student ratings of flavor and sensory ratings for purity of green.

SUMMARY AND CONCLUSIONS

A research project was conducted in two parts based upon conclusions of previous studies by Johnson (11) and by Rieley et al. (12). Both researchers suggested further study was needed to determine if proper preparation techniques could improve food quality. Objectives of part 1 of the study were to assess time/temperatures and holding times of cooked vegetables, to conduct training programs on batch cooking of vegetables, and to assess the effectiveness of training on time/temperature relationships and holding times (13). The objectives of this research were to assess the influence of training on plate waste, to compare student ratings of cooked vegetables before and after vegetable preparation training, and to determine if quality characteristics, as measured by a professional sensory panel, are affected by proper training in vegetable preparation techniques.

Student evaluations of vegetable quality, plate waste data, and sensory quality ratings were collected in five elementary schools on two non-consecutive days prior to and following a cook's training program on vegetable preparation. Frozen chopped broccoli was prepared and served on days of data collection. At the completion of lunch, fifth and sixth grade students evaluated temperature, flavor, appearance, and amount of broccoli served. Plate waste was assessed by members of the Research Support Group, who were trained in using the visual method of plate waste assessment. A six-member professional sensory panel rated broccoli for quality characteristics of purity of green and firmness.

Student ratings for flavor and appearance were "bad" to "so-so" for all schools. Three of the five schools showed improved ratings for flavor and two schools showed improved ratings for appearance following the cooks' training, although none of the improvements were significant. Student ratings of temperature were "too cool" for all schools, although improvement was indicated in two schools post training, one of which was significant.

Results of sensory panel ratings indicated an improvement in purity of green at three schools post training, and firmness of the broccoli in four schools, however none of these improvements were found significant. A highly significant improvement in temperature was recorded by the sensory panel in one school. All four remaining schools showed a decrease in temperature, at the time of the sensory evaluation, with one school having a highly significant decrease.

A moderate negative correlation was found between student ratings of flavor and appearance and plate waste (-.48 to -.76) suggesting as student ratings of the broccoli increased, plate waste decreased. A moderate correlation ($r = .70$) also was evident between ratings of amount served and plate waste. A high correlation ($r = .80$) was found between the sensory panel ratings for firmness and purity of green.

Results of part 1 of the study indicated training was very effective in reducing holding times of vegetables for all schools, but was not effective in increasing serving temperature. The influence of the training program on plate waste, student ratings and vegetable quality is difficult to assess. Although student and sensory ratings improved and plate waste declined in many schools, few of the changes were significant. The data suggests, however, training on vegetable preparation induced change in procedures by cooks which resulted in slightly improved acceptability and quality of the vegetable.

Although student ratings correlated highly with plate waste, the study was not designed to link individual student ratings with that student's plate waste. Additional research to determine if improvement in vegetable quality could be assessed by linking an individual's responses and plate waste. Increased popularity in service of fresh uncooked vegetables from a salad bar also should be considered as an alternative means of providing vegetables in students' diets. Research comparing acceptability and plate waste of fresh to cooked vegetables is needed.

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APPENDIXES

APPENDIX A

Letters to Dean of College of Education and to Superintendent

(KSU Letterhead)

November 8, 1985

Dr. David R. Byrne
Dean, College of Education
Bluemont Hall, Room 006
Kansas State University
Manhattan, KS 66502

Dear Dr. Byrne:

We are seeking your approval of a research project funded by the Agricultural Experiment Station. The study, which will be conducted through the department of Dietetics, Restaurant, and Institutional Management, will focus on the preparation and acceptance of vegetables served in several of the Manhattan schools. Previous studies conducted in these schools have indicated a high degree plate waste of vegetables. In our proposed study, we plan to explore factors which might contribute to the acceptability and consumption of vegetables. Mrs. Sue Greig, District Director of Foodservice, has encouraged us to proceed with the study and has shown support for the project.

Woodrow Wilson, Northview, Amanda Arnold, Lee, Theodore Roosevelt, and Eugene Field have been selected as the proposed sites for the study. Several types of data will be collected. Cooks in each kitchen will be observed during actual meal preparation on several occasions. Information on preparation procedures and time-temperature relationships will be recorded. In addition, several quality characteristics that may affect acceptability will be assessed by both a professional sensory panel and the upper level elementary students. Plate waste will be observed by the research team at the conclusion of lunch time. Following lunch in the cafeteria, students will be asked to complete a short evaluation form on the vegetable they were served, which should not take more than five minutes.

We have discussed the proposed project with the College of Human Ecology subcommittee on research involving human subjects. The focus of this research is considered to be exempt from Human Subject review as stated in Federal regulations 45 CFR 46.

We plan to begin observations of food preparation in the school foodservice kitchens in December, 1985, and will continue through January. Data from the students and the sensory panel will be collected in January.

We will appreciate your early consideration of this project. Your approval is necessary before we seek permission from Dr. Hal Rowe, Superintendent of USD 383. We would like to present the research project to the Manhattan elementary school principals at their meeting November 27, 1985. If you have any questions, please contact us at 532-5521.

Thank you for taking time to review this project.

Sincerely,

Almaz Rufael Graduate Research Assistant	Karla Sue Devan Graduate Student

Mary Gregoire, Ph.D., R.D.
Assistant Professor

cc: Dr. Hal Rowe
    Mrs. Sue Greig
    Dr. Marian Spears

(KSU Letterhead)

November 13, 1985

Dr. Hal Rowe
Superintendent of USD 383
2031 Poyntz
Manhattan, Kansas 66502

Dear Dr. Rowe:

The Department of Dietetics, Restaurant and Institutional Management at Kansas State University has requested an approval from Dr. David Byrne, Dean of the College of Education, for a vegetable acceptability research project we propose conducting in the elementary schools in Manhattan. A copy of the letter sent to Dr. Byrne is enclosed for your information. Pending the approval of the project, we would like to present the study to elementary school principals at their meeting on November 27, 1985.

Thank you for your cooperation.

Sincerely,

Almaz Rufael Graduate Research Assistant	Karla Sue Devan Graduate Student

Mary Gregoire, Ph.D., R.D.
Assistant Professor

(KSU Letterhead)

January 20, 1986

Dr. David R. Byrne
Dean, College of Education
Bluemont Hall, Room 006
Kansas State University
Manhattan, Kansas 66502

Dear Dr. Byrne:

We are seeking your approval for the continuation of a research project funded by the Agricultural Experiment Station. The study, which will be conducted through the department of Dietetics, Restaurant and Institutional Management, will involve the training of school foodservice employees on the techniques of batch cooking of vegetables as a means of improving the quality of the vegetables served. Mrs. Sue Greig, District Director of Foodservice, is supportive of the proposed training and has encouraged us to proceed with the study.

The continuation of our previous project, outlined in a letter to you on November 8, is requested based on the data we have collected. Several factors which might contribute to the acceptability and consumption of vegetables have been determined. We have been observing the preparation of vegetables in five of the elementary school kitchens and have been recording time-temperature relationships. These data and the results from a previous study indicate that vegetables are often prepared early in the day and held for extended periods before service. In many cases the temperature and quality of the vegetable declines during the holding period.

Our research plan is to conduct both group and individual training sessions on batch cooking of vegetables with the cooks at Amanda Arnold, Eugene Field, Marlatt, Northview, and Woodrow Wilson schools. The desired outcomes from the training program will be shortened holding time of vegetables and improved temperature and quality of vegetables at time of service. In order to evaluate the success of the training program, we propose to again collect observational data in the kitchens, sensory panel and student evaluations, and plate waste data.

We have discussed the proposed project with the College of Human Ecology subcommittee on research involving human subjects. The focus of this research is considered to be exempt from Human Subject review as stated in Federal regulation 45 CFR 46.

We would like to complete the project before the spring semester ends, thus if the study is approved, we plan to begin the training sessions in late February and will continue the training in March. The collection of the post-training information, which includes the kitchen observations, student and sensory panel evaluations and plate waste assessments, would occur in April.

We will appreciate your early consideration of this project. Your approval is necessary before we can seek approval from Dr. Hal Rowe, Superintendent of USD 383 and we would like to gain his approval for the project before the end of January. If you have any questions, please contact us at 532-5521.

Thank you for taking time to review this project.

Sincerely,

Almaz G. Rufael, R.D.
Graduate Research Assistant

Karla Devan
Graduate Student

Mary B. Gregoire, Ph.D., R.D.
Assistant Professor

cc: Dr. Hal Rowe
Mrs. Sue Greig
Dr. Marian Spears

(KSU Letterhead)

January 21, 1986

Dr. Hal Rowe
Superintendent of USD 383
2031 Poyntz
Manhattan, Kansas 66502

Dear Dr. Rowe:

We are requesting your approval for continuation of the vegetable acceptability study we have been conducting in five of the elementary schools. Although we have not completed the data collection in all schools, the data which has been collected this month have confirmed the results of a previous study completed last spring, both indicating that the vegetables are often prepared in advance of service and held for various lengths of time. In many cases the quality and temperature of the vegetable declines during the holding period. We believe these factors have an impact on the acceptability of the vegetables when they are served.

We have proposed to Mrs. Sue Greig that a training program on batch cooking of vegetables may be beneficial to the USD 383 foodservice program and that we would like to conduct the training sessions with the cooks. Mrs. Greig has been supportive of our proposal and has encouraged us to continue with the project.

We have written to Dr. Byrne, Dean of the College of Education, for his approval of the project. A copy of that letter is enclosed.

The training program we propose would include both group and individual training. The group training session would be offered to all of the cooks in the USD 383 foodservice. The individual training would only be done with the cooks from the five elementary schools that are currently involved in our study: Amanda Arnold, Eugene Field, Marlatt, Northview, and Woodrow Wilson.

The desired outcomes from the training program would be shortened holding time of vegetables and improved temperature and quality of vegetables at the time of service. In order to evaluate the success of the training program we propose to again collect observational data in the kitchens, sensory panel and student evaluations, and plate waste data.

Our research plan, if this proposal is accepted, is to begin the training in late February and continue it through March. The post-training information (kitchen observations, student and sensory evaluations) would be collected in April. The observation of vegetable production in the kitchens and the recording of time-temperature relationships would occur four times in each kitchen. Student and sensory panel evaluations and plate waste data would be collected on two non-consecutive days in each school.

Thank you for your support of our research. We would like to have your approval by February 4, if possible, so that we can present our plan to the cook managers at their meeting on that day. If you have any questions on this proposed continuation of the project, please contact one of us at 532-5521.

Sincerely,

Almaz G. Rufael, R.D.
Graduate Research Assistant

Karla Sue Devan
Graduate Student

Mary B. Gregoire, Ph.D., R.D.
Assistant Professor

cc: Mrs. Sue Greig
Dr. Marian Spears

APPENDIX B

Data Collection Forms

STUDENT EVALUATION

School____________________ Date____________

Place an "X" under the word that best describes how you feel about the BROCCOLI today.

	GREAT	GOOD	SO-SO	BAD	AWFUL
TASTE					
LOOKS					

	TOO HOT	JUST RIGHT	TOO COOL
TEMPERATURE			

	TOO MUCH	RIGHT AMOUNT	TOO LITTLE
AMOUNT			

(COLOR BLUE)

STUDENT EVALUATION

School________________________ Date________________

Place an "X" under the word that best describes how you feel about the BROCCOLI today.

	GREAT	GOOD	SO-SO	BAD	AWFUL
TASTE					
LOOKS					

	TOO HOT	JUST RIGHT	TOO COOL
TEMPERATURE			

	TOO MUCH	RIGHT AMOUNT	TOO LITTLE
AMOUNT			

(COLOR GREEN)

SENSORY EVALUATION SCORE CARD

Name ____________________________ Date ______________________

School ____________________

BROCCOLI _____°C

Please indicate the intensity of each characteristic of the vegetable. Mark with a perpendicular line.

Purity of Green:

____

Extremely dull Extremely bright

Firmness:

____

Very mushy Very firm

Comments:

KANSAS STATE UNIVERSITY
Department of Dietetics, Restaurant and Institutional Management

Observational Plate Waste Form

School Name ______________________ Date __________________

Scale:
4. If a full portion remains
3. If 3/4 of a portion remains
2. If 1/2 of a portion remains
1. If 1/4 of a portion remains
0. If none remains, but you can tell it has been served
(-) If there is no evidence that the food item was served

Please circle the appropriate number

Tray	Rating Scale						Tray	Rating Scale					
(1)	4	3	2	1	0	-	(17)	4	3	2	1	0	-
(2)	4	3	2	1	0	-	(18)	4	3	2	1	0	-
(3)	4	3	2	1	0	-	(19)	4	3	2	1	0	-
(4)	4	3	2	1	0	-	(20)	4	3	2	1	0	-
(5)	4	3	2	1	0	-	(21)	4	3	2	1	0	-
(6)	4	3	2	1	0	-	(22)	4	3	2	1	0	-
(7)	4	3	2	1	0	-	(23)	4	3	2	1	0	-
(8)	4	3	2	1	0	-	(24)	4	3	2	1	0	-
(9)	4	3	2	1	0	-	(25)	4	3	2	1	0	-
(10)	4	3	2	1	0	-	(26)	4	3	2	1	0	-
(11)	4	3	2	1	0	-	(27)	4	3	2	1	0	-
(12)	4	3	2	1	0	-	(28)	4	3	2	1	0	-
(13)	4	3	2	1	0	-	(29)	4	3	2	1	0	-
(14)	4	3	2	1	0	-	(30)	4	3	2	1	0	-
(15)	4	3	2	1	0	-	(31)	4	3	2	1	0	-
(16)	4	3	2	1	0	-	(32)	4	3	2	1	0	-

Scale:

4. If a full portion remains
3. If 3/4 of a portion remains
2. If 1/2 of a portion remains
1. If 1/4 of a portion remains
0. If none remains, but you can tell it has been served

(-) If there is no evidence that the food item was served

Tray	Rating Scale						Tray	Rating Scale					
(33)	4	3	2	1	0	-	(53)	4	3	2	1	0	-
(34)	4	3	2	1	0	-	(54)	4	3	2	1	0	-
(35)	4	3	2	1	0	-	(55)	4	3	2	1	0	-
(36)	4	3	2	1	0	-	(56)	4	3	2	1	0	-
(37)	4	3	2	1	0	-	(57)	4	3	2	1	0	-
(38)	4	3	2	1	0	-	(58)	4	3	2	1	0	-
(39)	4	3	2	1	0	-	(59)	4	3	2	1	0	-
(40)	4	3	2	1	0	-	(60)	4	3	2	1	0	-
(41)	4	3	2	1	0	-	(61)	4	3	2	1	0	-
(42)	4	3	2	1	0	-	(62)	4	3	2	1	0	-
(43)	4	3	2	1	0	-	(63)	4	3	2	1	0	-
(44)	4	3	2	1	0	-	(64)	4	3	2	1	0	-
(45)	4	3	2	1	0	-	(65)	4	3	2	1	0	-
(46)	4	3	2	1	0	-	(66)	4	3	2	1	0	-
(47)	4	3	2	1	0	-	(67)	4	3	2	1	0	-
(48)	4	3	2	1	0	-	(68)	4	3	2	1	0	-
(49)	4	3	2	1	0	-	(69)	4	3	2	1	0	-
(50)	4	3	2	1	0	-	(70)	4	3	2	1	0	-
(51)	4	3	2	1	0	-	(71)	4	3	2	1	0	-
(52)	4	3	2	1	0	-	(72)	4	3	2	1	0	-

APPENDIX C

Data Collection Schedules

KANSAS STATE UNIVERSITY, COLLEGE OF HUMAN ECOLOGY
Department of Hotel, Restaurant, Institution Management & Dietetics

Data Collection
Schedule for Research Support Group
After training cooks
Friday, January 17

School	Student Evaluation (observation number)	Plate Waste (observation number)	Serving Time
A	6	7	12:10
B	10	8	12:00
C	3	5	11:55
D	11	9	11:30 & 12:30
E	2	4	11:35 & 12:00

Friday, January 31

School	Student Evaluation (observation number)	Plate Waste (observation number)	Serving Time
A	2	4	12:10
B	3	5	12:00
C	10	8	11:55
D	11	9	11:55 & 12:30
E	6	7	11:35 & 12:00

KANSAS STATE UNIVERSITY, COLLEGE OF HUMAN ECOLOGY
Department of Hotel, Restaurant, Institution Management & Dietetics

Data Collection
Schedule for Research Support Group
After training cooks

Friday, April 18

School	Student Evaluation (observer number)	Plate Waste (observer number)	Serving Time
A	6	3	12:10
B	8	1	12:00
C	7	4	11:55
D	9	5	11:30 & 12:30
E	10	2	11:35

Friday, May 2

A	9	5	12:10
B	7	4	12:00
C	11	2	11:55
D	8	1	11:30
E	6	3	11:35

KANSAS STATE UNIVERSITY, COLLEGE OF HUMAN ECOLOGY
Department of Hotel, Restaurant, Institution Management & Dietetics

Data Collection
Schedule for Sensory Panel
Prior to training cooks
Friday, January 17

School	Sensory Panel Members	Serving Time
School A	Member 5 Member 6	11:30
School C	Member 5 Member 6	12:00
School E	Member 3 Member 1	11:30
School D	Member 3 Member 1	12:15
School B	Member 2 Member 4	11:30

(Color Blue)

KANSAS STATE UNIVERSITY, COLLEGE OF HUMAN ECOLOGY
Department of Hotel, Restaurant, Institution Management & Dietetics

Data Collection
Schedule for Sensory Panel
Prior to training cooks
Friday, January 31

School	Sensory Panel Members	Serving Time
School E	Member 2 Member 3	11:30
School C	Member 2 Member 3	12:00
School B	Member 1 Member 5	11:30
School D	Member 1 Member 5	12:15
School A	Member 4 Member 6	11:30

(Color Blue)

KANSAS STATE UNIVERSITY, COLLEGE OF HUMAN ECOLOGY
Department of Hotel, Restaurant, Institution Management & Dietetics

Data Collection
Schedule for Sensory Panel
After training cooks
Friday, April 18

School	Sensory Panel Members	Serving Time
School A	Member 3 Member 4	11:30
School C	Member 3 Member 4	12:00
School E	Member 1 Member 5	11:30
School D	Member 1 Member 5	12:15
School B	Member 2 Member 6	11:30

KANSAS STATE UNIVERSITY, COLLEGE OF HUMAN ECOLOGY
Department of Hotel, Restaurant, Institution Management & Dietetics

Data Collection
Schedule for Sensory Panel
After training cooks
Friday, May 2

School	Sensory Panel Members	Serving Time
School E	Member 2 Member 5	11:30
School C	Member 2 Member 5	12:00
School B	Member 1 Member 4	11:30
School D	Member 1 Member 4	12:15
School A	Member 3 Member 6	11:30

(KSU Letterhead)

Data Collection Schedule

Date	Event	Location
December 3	Meet with school food service employees	Education building
December 6	Test observation instrument	School E[2]
December 18	Train graduate students in data collection	Kansas State University
January 7	Observation of production techniques	Schools A[1] and B[2]
January 9	Observation of production techniques	Schools A and A
January 10	Observation of production techniques	Schools A and E
January 14	Meet with sensory panel	Kansas State University Quantity Food Laboratory
	Observation of production techniques	Schools A and
January 15	Train graduate students in data collection	Kansas State University Quantity Food Laboratory
January 16	Observation of production techniques	School E
January 17	Collection of data from sensory panel and students	Schools A, B, C[1], D[1], and E
	Observation of production techniques	Schools B and D
January 21	Observation of production techniques	Schools A and C

---

[1] Conventional.

[2] Satellite with finishing kitchen.

January 23	Observation of production techniques	Schools C and D
January 24	Observation of production techniques	School B
January 28	Observation of production techniques	Schools D and E
January 30	Observation of production techniques	Schools E
January 31	Collection of data from sensory panel and students	Schools A, B, C, D, and E
	Observation of production techniques	Schools C and D

(KSU Letterhead)

Data Collection Schedule

Date	Event	Location
April 8	Observation of production techniques	A[1] and B[2]
April 10	Observation of production techniques	A and B
April 15	Observation of production techniques	A and E[2]
April 17	Observation of production techniques	A and C[2]
April 18	Observation of production techniques	D[1] and E
	Collection of data from sensory panel and students	A, B, C, D, E, and E
April 24	Observation of production techniques	C and E
April 25	Observation of production techniques	C and D
April 29	Observation of production techniques	B and D
May 1	Observation of production techniques	B and E
May 2	Observation of production techniques	C
	Collection of data from sensory panel and students	A, B, C, D, and E
May 6	Observation of production techniques	E

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1. Conventional.
2. Satellite with finishing kitchen.

APPENDIX D

Supplemental Tables
(Tables 5-9)

Table 5. Correlations of student ratings, plate waste, and sensory ratings for broccoli for school A

	student ratings				plate waste	sensory ratings		
	flavor	appearance	temperature	amount		temp	purity	firmness
flavor								
appearance	-.41							
temperature	.53	-.70						
amount	-.13	-.85	.50					
plate waste	-.04	-.22	-.50	.15				
temp	.70	-.47	.93	.16	-.58			
purity	-.96*	.64	-.67	-.15	-.07	-.75		
firmness	-.20	.96*	-.72	-.94*	-.05	-.45	.46	

*Correlation significant at $p \leq .05$.

**Correlation significant at $p \leq .01$.

Table 6. Correlations of student ratings, plate waste, and sensory ratings for broccoli for school B

	student ratings				plate waste	sensory ratings		
	flavor	appearance	temperature	amount		temp	purity	firmness
flavor								
appearance	-.13							
temperature	.69	.48						
amount	-.99**	.19	-.65					
plate waste	-.72	.32	-.07	.77				
temp	-.18	-.29	.11	.27	.67			
purity	-.25	.69	.52	.31	.80	.50		
firmness	.20	.82	.84	-.17	.36	.15	.85	

*Correlation significant at $p \leq .05$.

**Correlation significant at $p \leq .01$.

Table 7. Correlations of student ratings, plate waste, and sensory ratings for broccoli for school C

	student ratings				plate waste	sensory ratings		
	flavor	appearance	temperature	amount		temp	purity	firmness
flavor								
appearance	.89							
temperature	.99**	.89						
amount	-.82	-.63	-.72					
plate waste	-.96	-.84	-.90	.94*				
temp	.64	.87	.72	-.18	-.49			
purity	-.71	-.36	-.62	.91	.80	.08		
firmness	-.83	-.53	-.74	.95*	.90	-.10	.98**	

*Correlation significant at $p \leq .05$.

**Correlation significant at $p \leq .01$.

Table 8. Correlations of student ratings, plate waste, and sensory ratings for broccoli for school D

	student ratings				plate waste	sensory ratings		
	flavor	appearance	temperature	amount		temp	purity	firmness
flavor								
appearance	.62							
temperature	.39	.79						
amount	-.71	-.02	.37					
plate waste	-.20	-.50	.09	.27				
temp	-.49	-.26	.37	.77	.81			
purity	.95*	.59	.19	-.81	-.45	-.73		
firmness	.88	.19	.01	-.89	.03	-.48	.85	

*Correlation significant at $p \leq .05$.

**Correlation significant at $p \leq .01$.

Table 9. Correlations of student ratings, plate waste, and sensory ratings for broccoli for school E

	student ratings				plate waste	sensory ratings		
	flavor	appearance	temperature	amount		temp	purity	firmness
flavor								
appearance	.94							
temperature	.37	.13						
amount	-.75	-.80	-.52					
plate waste	-.78	-.51	-.74	.46				
temp	-.17	.19	-.77	-.06	.75			
purity	.63	.59	-.30	-.001	-.42	.01		
firmness	.35	.24	-.35	.36	-.34	-.15	.92	

*Correlation significant at $p \leq .05$.

**Correlation significant at $p \leq .01$.

EVALUATION OF A VEGETABLE PREPARATION TRAINING PROGRAM PART II: ASSESSED BY PLATE WASTE OBSERVATION, STUDENT AND SENSORY PANEL RATINGS

by

KARLA S. DEVAN

B.S., Ouachita Baptist University, 1971

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Hotel, Restaurant, and Institution
Management and Dietetics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1987

ABSTRACT

The purpose of this research was to evaluate the effectiveness of an employee training program as a means of improving quality of cooked vegetables in school foodservice. Specific objectives of this study were: to assess the influence of vegetable preparation training on the amount of vegetable plate waste; to compare student ratings of cooked vegetables before training to ratings after training; and to determine if quality characteristics, as measured by a professional sensory panel, are affected by proper training in vegetable preparation techniques. Chopped broccoli, purchased frozen, was chosen for evaluation because of the effect of poor preparation techniques on color, texture, and acceptability. Fifth and sixth grade students in five elementary schools in a Kansas school district participated in this study. Acceptability was evaluated by the students and plate waste was assessed visually by trained observers. Student evaluations consisted of their responses to queries about flavor, appearance, temperature, and serving size of the broccoli. A professional sensory panel evaluated quality characteristics of purity of green and firmness of broccoli.

Data analysis focused on comparison of pre- and post training data of student evaluations, plate waste observations, and sensory quality ratings. Student ratings for broccoli flavor and appearance were "bad" to "so-so" for all schools. Serving size was rated "just right," and temperature was rated "too cool" with a significant increase in temperature for one school. Reduction in plate waste was indicated in two of the five schools following training, one of which was significant. Sensory ratings of broccoli indicated improvement in purity of green and firmness in most schools, however, no significant improvement was found. A negative correlation was found between student ratings of the broccoli and plate waste, indicating that as student ratings of the vegetable increased, plate waste decreased.